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Meeting abstract

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304 An non subjective method for myocardial T2* curve fitting in thalassemia

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Purpose

To assess the effectiveness of the proposed automatic T2* curve fitting method for myocardial iron measurement.

Introduction

The measurement of cardiac iron is essential for preventing disease and managing iron-chelating treatment in thalassemia patients. A T2* technique has been developed and clinically validated for this purpose [1,2]. However, this technique can be affected by noise, motion and blood artifacts. This is a particular problem for heavily iron loaded hearts where the very short T2* (< 10 ms) results in a rapid decay in myocardial signal intensity leading to a plateau for the low signal to noise ratio (SNR) in the later echo time images. By using a simple monoexponential model, the curve fitting is usually poor with T2* overestimated (Figure 1). In our previous work, we have used a truncation model where the late "plateau" points are subjectively discarded (Figure 1, red circles) and then the remaining signal is fitted with a mono exponential equation. Although different approaches have been proposed to understand this, we have shown [3,4] that the truncation model produces more reproducible and accurate T2* measurements.

For the truncation model the observer makes a decision on which points to discard and this has the potential to introduce a measurement error. In our experience, however, the decision is reasonably clear and the measurement difference between inclusion and exclusion of an uncertain point is also not large. However, to avoid this subjectivity we were motivated to develop an automatic procedure to enhance the clinical applications of the T2* technique.

Methods

In total 255 thalassemia patients were scanned on a 1.5 T MRI scanner (Siemens Sonata) using the breath-hold T2* sequence [2]. A single mid-ventricular short axis slice was imaged with T2* measured in the left ventricular septum. The study was approved by the local ethics committee and all patients gave informed consent.

The proposed non subjective method is based on the R-square value, which represents the goodness of fitting. The method is composed of following procedures. (a) If the R-square value is more than 0.995 for all the 8 data points, accept the T2* value. (b) Otherwise, repeatedly eliminating the last data point until the R-square value is more than 0.995 and then keep eliminating the last data point until the T2* value is shortened by less than 2.5% after the elimination. (d) For normal subjects with longer T2*'s > 20 ms, although the R-squared value is normally greater than 0.995, this occasionally may not be the case because of artifact. In this case, however, as the measurement is in the normal range it is accepted irrespectively

These rules were applied to all patient data analyses to produce non subjective measurements. The results were

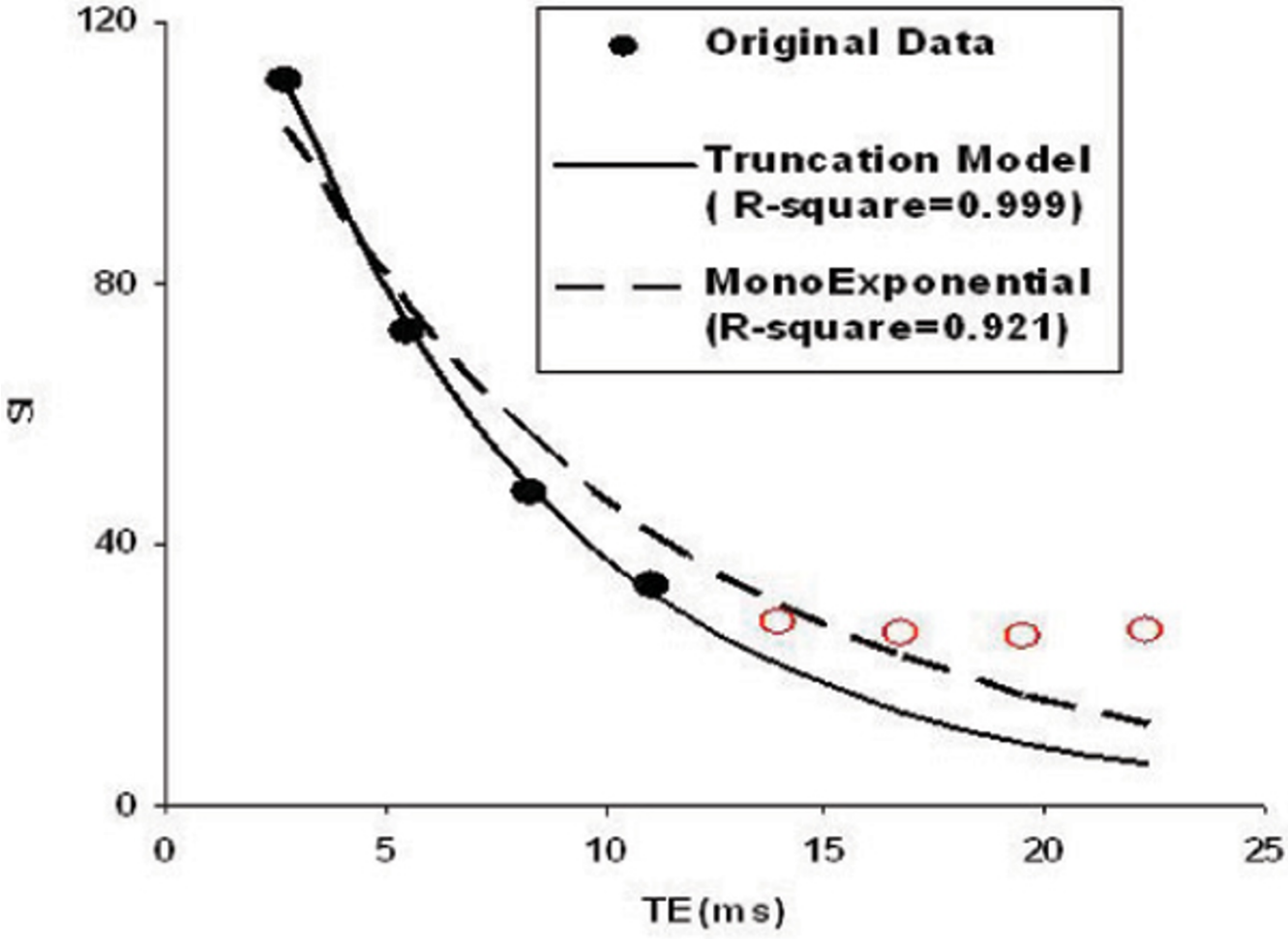

Figure 1. An example showing patient data fitted using both the monoexponential truncation models.

Figure 1
An example showing patient data fitted using both the monoexponential truncation models.

then compared with the T2* measurements conducted by three experienced clinical fellows.

Results

Figure 2 demonstrates the histogram of the discrepancy between the non subjective and subjective methods. Figure 3 shows the scatter plot of the comparison between these two methods. The coefficient of variation was 1.9% (n = 255).

Conclusion

This study has demonstrated the good reproducibility of the proposed non subjective method for myocardial T2* curve fitting when using the truncation model. This approach simplifies the overall analysis and can be easily incorporated into T2* measurement software.

Acknowledgements

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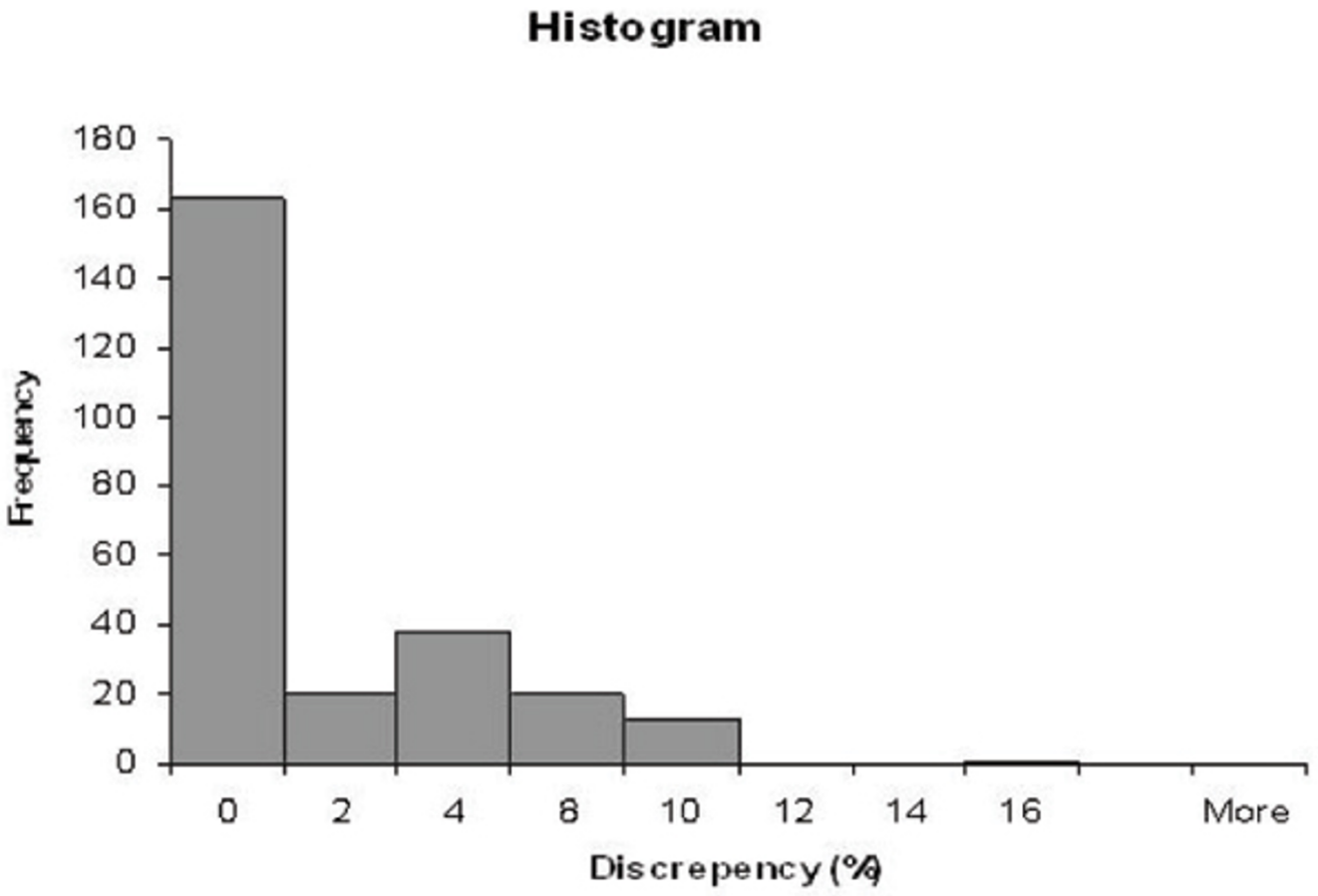

Figure 2
Histogram of the T2* discrepancies between the proposed and the subjective methods.

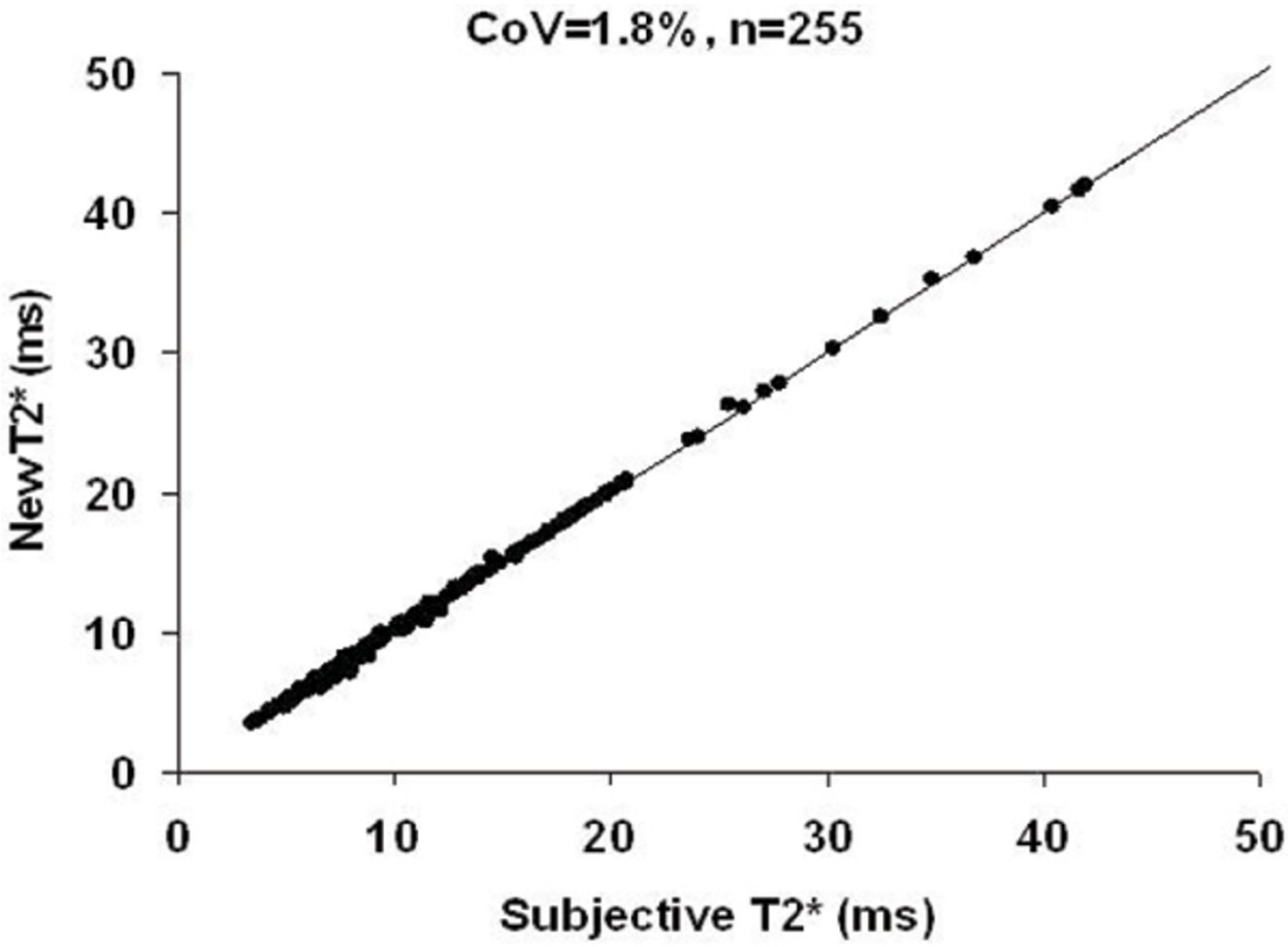

Figure 3
Scatter plot with the line of identity, showing the comparison of the T2* measurements using the proposed and the subjective methods.